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The ILLUMINATING ENGINEER

ELECTRICITY · ACETYLENE · OIL · GAS

Edited by LEON GASTER

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THE JOURNAL OF SCIENTIFIC ILLUMINATION.

1/- a Copy.

OFFICIAL ORGAN OF THE
Illuminating Engineering Society.
(Founded in London 1909.)

This number contains the Discussion on ***"Economy in Lighting in relation to Fuel Saving"*** which took place at the Annual Meeting of The Illuminating Engineering Society on May 15th, 1917.

Other matters dealt with include:

RADIUM LUMINOUS PAINT—FLOODLIGHTING OF THE NATIONAL CAPITOL (U.S.A.)—EFFECTIVE SHOP WINDOW LIGHTING—ARCS UNDER PRESSURE, &c.

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EDITORIAL.

Economy in Lighting in Relation to Fuel-Saving.

The discussion on the above subject at the Annual Meeting of the Illuminating Engineering Society on May 15th (see pp. 131-136) was very timely. Now that the summer months are with us it is a fitting time to consider what steps may be necessary before the dark days of winter, when artificial lighting is mainly required.

The first point to establish is the extent of the fuel saving that may reasonably be expected to follow from judicious restrictions in lighting. From the figures presented before the Committee on the Summer Time Act (1916) it would appear that gas and electric supply companies consume for lighting purposes only about 2½ per cent. of the entire coal supply. Consequently, even if we were able to bring about a general saving of 10 per cent., the corresponding diminution in fuel used would not exceed a quarter of one per cent. The most fruitful field for economy, as suggested by Mr. Faraday Proctor and Mr. Crowley, lies in the more efficient use of our coal for power production, especially in view of the fact that our industrial

future will doubtless demand the utilisation of power to a greater degree than at present.

Nevertheless there are good reasons for desiring the elimination of waste of light—a thing which the Society has always condemned as objectionable even in time of peace, and especially so in the present circumstances. It must be remembered that the amount of coal available for lighting purposes is necessarily limited at present, not only because of the shortage of coal, but also because of the greatly increased demands on gas and electric supply companies for power purposes. In some districts it is common knowledge that companies find a difficulty in coping with this demand and would therefore welcome any diminution in luxury lighting, especially at the peak time of the load. The avoidance of waste of light has also a moral justification, because members of the general public, noting the lavish use of light for spectacular purposes, but not knowing how small the fuel so consumed is in relation to the total consumption, might jump to the conclusion that the shortage of fuel had been exaggerated.

For these reasons judicious economy in lighting would be welcome. It should, however, be secured in a scientific and well-considered way. It is now generally agreed that an indiscriminate diminution of, say, 10 per cent. would not be desirable. Light is not a luxury but an essential commodity for industrial and manufacturing processes ; it would clearly be bad policy, at a time like the present when every factory is working at high pressure, to risk a diminution in output or impairment of quality through insufficient light. It was therefore suggested that any compulsory diminution in lighting should apply, *first*, to luxury and spectacular lighting, *second* (and only in extreme emergency), to lighting desirable in the interests of public convenience, but in no case to industrial and munitions works, nor in circumstances where it is necessary to public safety. The division of the existing lighting into these respective categories, with due consideration of the needs of each district, would obviously require a considerable amount of technical experience, and it was suggested that the matter might be considered during the summer months by a Joint Committee, on which the Illuminating Engineering Society should be represented.

Meantime it is of interest to note that the Authorities have already proceeded in the direction indicated in this discussion. Only a week after the Annual Meeting an Order was issued (see p. 148) prohibiting the use of lights for outdoor display, street-signs, &c. There is little doubt that in the present darkened condition of the streets the exhibition of such powerful lights is undesirable from the standpoint of public convenience and safety, as well as being wasteful, and we hope that even after the war is over there will be a thorough revision of methods of outside lighting.

Industrial Research in the United States of America.

We have received a copy of an interesting report on the above subject by Mr. A. P. M. Fleming, the first of a series to be issued by the Department of Scientific and Industrial Research. The Department are to be congratulated on their initiation of this useful piece of work, and we are confident that the periodical issue of information of this character will be very helpful in guiding public opinion in the right direction. We hope to give a fuller account of Mr. Fleming's report in our next issue, but meantime would like to refer to some of its leading features.

The industrial researches described by Mr. Fleming are classified according to whether they are undertaken by manufacturing corporations, associations of manufacturers, universities and colleges, national institutions, commercial laboratories, and scientific societies. There is obviously room in these classes for many different varieties of research work, and it is interesting to note that in some cases purely industrial concerns carry out a considerable amount of research in pure science, which they regard as a public service. The reader cannot fail to be impressed by the lavish scale on which many such institutions are carried on, and here Mr. Fleming has done a useful service by including in his account a series of photographs showing the exteriors and equipment of typical laboratories.

We believe that these illustrations will serve to convey to readers, much more vividly than any verbal description could do, the magnitude of these undertakings. The inclusion of such photographs in a Government publication is a welcome departure which, we hope, will be followed in many such scientific productions in the future.

Another step on which the Department are to be congratulated is the issue of an appropriate abstract of the Report, which should be very helpful to technical journalists and others who wish to obtain a rapid but exact survey of its essential points. We notice that, in emphasising the desirability of bringing constantly before the public mind the benefits to be derived from scientific and industrial research, Mr. Fleming alludes to the services that can be rendered by the Press, especially journals of a scientific, technical, or trade character. Such journals could play an important part in informing the public on these matters, and it is essential that they, in turn, should be kept fully informed of what the Department is doing. Co-operation with the scientific and technical press in such matters requires to be carefully fostered. Concise information as to what has been done in this direction abroad is most useful, and we hope that it will be followed by concrete examples of the advantages that have already been gained by the application of scientific knowledge by leading manufacturers in this country. The dissemination of such information in the scientific and technical press cannot fail to have a stimulating influence on industry and will be well repaid by the progress to which it gives rise.

Radium Luminous Compounds.

In the March issue of the ILLUMINATING ENGINEER we commented upon the interesting discussion of "Fluorescence and Phosphorescence, and their use to Produce Luminous Effects," initiated by Mr. F. Harrison Glew at the meeting of the Illuminating Engineering Society on March 22nd.

The series of investigations on Radium Luminous Compounds, described in a paper by Messrs. Paterson, Walsh and Higgins before the Physical Society on May 25th, form a useful supplement to the foregoing discussion, and we are giving an abstract of this paper in the present issue (pp. 137-141). The most interesting feature in the paper is a series of curves showing the progress of the decay in brightness of radium compounds of various strengths. The main conclusion reached by the authors seems to be that for compositions which are intended to be used for long periods there is little advantage in using a strength of radium exceeding 0·2 milligram per gramme of composition. This is a useful result in view of the expensive nature of these compounds, and also because they are so frequently kept in store for a considerable period previous to their being actually employed in practice.

The description of the photometric difficulties encountered, and the apparatus used in overcoming them, generally bears out what was said at the meeting of the Illuminating Engineering Society. No doubt when the war is over similar tests by other observers will be available, and it will be interesting to compare them with those now published.

One would also like to know what steps have been taken to ascertain the exact order of luminosity necessary for the various functions of these paints. On the ground of expense it is desirable to diminish the radium content as far as possible, and, in view of the high sensitiveness of the eye in total darkness, it is possible that a very minute proportion of radium, yielding a luminosity much less than that commonly employed, might sometimes be found to be sufficient. The determination of the best sizes of figure for luminous dials, described by the authors, is a good instance of how such problems should be investigated. In course of time the uses of radium luminous paint will probably be considerably extended, and the question of brightness in relation to conditions of use will doubtless be studied in fuller detail.

The authors do not enter into the complicated problem of the chemical and physical conditions which give rise to fluorescence and phosphorescence. An interesting letter, just received from Dr. J. E. Sheppard, of the Eastman Kodak Co., which we contemplate publishing in our next number, suggests that the chemical conditions giving rise to these two phenomena are essentially different. The study of such effects may yield much useful information as to what takes place within the atom, and may eventually profoundly influence present theories of chemical and physical action.

LEON GASTER.

TRANSACTIONS

OF

The Illuminating Engineering Society.

(Founded in London, 1909.)

The Illuminating Engineering Society is not, as a body, responsible for the opinions expressed by individual authors or speakers.

ECONOMIES IN LIGHTING IN RELATION TO FUEL SAVING.

(Discussion at the Annual Meeting of the Society held at the house of the Royal Society of Arts, 18, John Street, Adelphi, London, W., on May 15th, 1917.)

AT the conclusion of the formal business at the annual meeting of the Society, which was reported in our last issue,* a discussion took place on "Economies in Lighting in relation to Fuel Supply," the President-Elect, Mr. A. P. Trotter, being in the Chair.

The discussion was opened by an introductory address by Mr. L. Gaster.

Mr. L. GASTER said that the subject for discussion had a special interest for the Illuminating Engineering Society, which included amongst its members engineers concerned with the supply of gas and electricity, makers of lamps and lighting appliances (gas, oil, acetylene, electricity, &c.), and users of illumination on a large scale.

The first point to consider was the extent of the economy in fuel that could in any circumstances be expected to result from restriction in lighting. We should then consider this possible saving in relation to its effect on industry, public convenience, and safety. Artificial light was no longer regarded as a luxury, but as a public necessity, in the same way as fresh air, heat, and water supply. The Report of the Departmental Committee on Lighting in Factories and Workshops, issued in 1915, placed illumination on the same footing as these commodities—as an essential item in industrial work. We should, therefore, select carefully the directions in which economy is to be exercised.

According to the Estimates issued by the Board of Trade (issued March 17th, 1917), the output of coal in the United Kingdom during the last four years was as follows:—

	Million tons (approx.)
1913	287
1914	265
1915	253
1916	256

While, therefore, the output during 1916 showed a small advance over 1915, there was still a diminution of over 30 million

* *Illum. Eng.*, April, 1917, pp. 103-107.

tons as compared with the last year before the war.

In giving evidence before the Committee on the Summer Time Act, Mr Faraday Proctor, the Hon. Secretary of the Incorporated Municipal Electrical Association, stated that the total units generated for both electric light and power is about 2,000 millions, and of this about 23 per cent. is estimated to be used for lighting. Assuming, roughly, 4½ lbs. of coal per unit sold, this would be equivalent to about one million tons of coal used for the lighting load.

Similarly, Mr. Hanbury Thomas, of the Sheffield United Gas Co., estimated the total consumption of coal by the gas industry in 1915 to be about 18 million tons, of which probably about a quarter might be used for lighting. The consumption of coal for lighting by gas and electricity supply companies throughout this country was probably well within six million tons—only about 2½ per cent. of the total coal output.

Of this amount a very considerable proportion was required for indispensable purposes, *e.g.*, in munition and other factories, in necessary public lighting, &c. Therefore one must not form too extravagant a conception of the possible economies in the lighting field.

This impression was confirmed by a study of the saving estimated to be accomplished during the operation for 4½ months of summer time, by the Summer Time Act, in 1916. According to the Report of the Committee witnesses estimated the saving from reduction in gas lighting at about 260,000 tons, and the corresponding saving on the part of electric supply companies at less than 60,000 tons on the highest estimate. The combined saving thus amounted to only about one-tenth per cent. of the total coal output.

As regards the detailed effect of the Summer Time Act, the effect obviously varies greatly according to the locality and the proportions of output used for private lighting and for industrial purposes. Mr. Proctor estimated the saving as from 0·39—1·9 per cent. of the total units sold in the United Kingdom. In Manchester, however, the decrease in four residential districts was as much as 15 per cent., but in the industrial areas an increase was even recorded.

Yet, while the possible fuel-saving brought about might be small, in times like this any waste of light should certainly be avoided.

It appeared impracticable to aim at a general reduction of, say, 10 per cent, irrespective of the purpose for which the light is applied. It would clearly be folly to attempt undue diminution in munition works and factories where the expenditure in securing adequate illumination is small in comparison with the benefits secured in the form of improved output, avoidance of spoiled work, and better health and spirits of workers.

Similarly, any economy by additional indiscriminate reduction of lighting in the streets would surely be of small value in proportion to the risk to safety and the public inconvenience so caused.

As a preliminary to any restriction of lighting with a view to fuel economy the division of illumination into four main categories might be suggested:—

(1) Safety (as regards prevention of accidents).

(2) Lighting for indispensable purposes (munition works, factories, &c.).

(3) Lighting for public convenience.

(4) Luxury and spectacular lighting.

The first two divisions of lighting clearly ought not to be interfered with, except in cases where it could be clearly and indisputably shown that the light was excessive or wrongly applied for the purpose in view. Division (3) would only be touched in case of grave necessity, while Division (4) would be the first to which further restrictions should be applied.

The classification under these four headings would naturally require care. But there were instances of light being used in a way which, while permissible even if not really desirable in ordinary circumstances, was hardly justifiable now. The exhibition of large numbers of lamps, or very powerful lamps of undue brilliancy, outside shops and places of entertainment was a bad policy. By a little ingenuity it should surely be possible to attract the public attention without this species of glare, and in the present circumstances these incentives to

visiting entertainments could not be considered strictly necessary.

In shop-window lighting, and in restaurants there is frequently waste of light. The allocation of a certain amount of gas or electricity to a shop-window for specified purposes or of given area might be considered, and methods of using the available light to the best advantage made more familiar to the general public.

In the first instance, it would probably be best to operate by educational methods rather than hard and fast regulations. If such an educational movement was based on the inculcation of the general principles governing the proper use of light (avoidance of glare, proper shading, &c.), it would have valuable results for the future, quite apart from its present utility as stimulating economy. One difficulty that would now have to be considered is the limitation in supply of efficient reflectors and other devices. But such appliances, though necessary to the highest development of lighting, are not absolutely essential in order to carry out the fundamental principles of good lighting, and many simple means of screening could be suggested that could be prepared without much trouble.

In conclusion, Mr. Gaster suggested that the whole question of economies in lighting should be referred to a Joint Committee, on which the Illuminating Engineering Society would be represented, during the summer months, with a view to advising the authorities regarding the best steps to be taken when the winter months arrived. Such a Committee, acting with official recognition and support, might survey the whole field of lighting, making broad classifications into the four categories suggested above, with due regard to the variety of circumstances in different districts. The same considerations as govern the division of industries into "essential" and "non-essential" would be borne in mind. Having further taken into account the effect both on the public and the lighting industry of any change, and the saving in coal that might be expected to result, it would be in a position to inform the Government where such a saving could be made with a minimum of risk and inconvenience.

Information of this kind would be of great value as a basis of action in the form of orders or legislation. The Committee might also prepare the ground for restrictions by drafting pamphlets for public distribution showing, by concrete examples, the amount of light necessary for various purposes, and the directions in which various sections of the public would be expected to economise.

Even should extreme economy in lighting happily be found unnecessary the information gained through such an inquiry would not be wasted but would provide useful material, especially to gas and electric supply companies, for the future.

The Chairman then called upon the Hon. Asst.-Secretary to read the following communication from Mr. H. Faraday Proctor.

Mr. H. FARADAY PROCTOR (*communicated*):— I believe it is a reasonable assumption that diminution in consumption of electricity due to economies being advocated would not exceed about 10%. Such a reduction would result in lowering the coal consumption of electrical undertakings by about 1½% only, having regard to the fact that the lighting units sold by electrical undertakers are only about 23% of the total units output. Such reduction would amount to about 60,000 tons of coal per annum for the whole kingdom.

The loss in revenue to the electrical undertakings would be in the neighbourhood of £500,000 per annum. As few, if any, electrical undertakers are making more than a reasonable profit on their capital outlay, a diminution in revenue unaccompanied by a corresponding diminution in costs must ultimately result in an increase in the charges, or at least in the postponement of a reduction of the same. In either case the consumer is not likely in the long run to reap a financial benefit commensurate with the reduction of his consumption of energy. It is, therefore, little use looking for a substantial reduction in coal consumption as resulting from economy in lighting.

To conserve coal the raw material must be used efficiently. The burning of coal as fuel prior to the abstraction of what we term, by-products, is in itself wasteful, but the great power stations are amongst the least sinful in their methods.

Assuming for the sake of argument that the coal consumption of the average, privately owned engine per H.P.-hour is double that of the engines in an up-to-date power house, the change over of only 16,000 K.W of load of 25% load factor from privately owned plant to public supply mains would result in a saving of about 60,000 tons of coal per annum. (The losses in beltings and other inefficiencies superseded being set against the electric transmission losses.) Thus a comparatively small change over by power users on to up-to-date methods of driving would result in economies that would balance those obtainable from general lighting economies, and would benefit all parties concerned.

Economy in lighting must be looked upon purely as a War measure, and that solely with a view to a small reduction in the coal consumption throughout the country. It must be realised that to bring about a substantial reduction in coal consumption wasteful methods must be abolished.

I trust and believe that in the near future the Government will bring pressure to bear upon the users of private plant, whether by taxation or otherwise, and they will be compelled to utilise the public supply wherever such is available on reasonable terms.

The end to be aimed at is that the burning of raw coal should be prohibited except to licensed users. The result would be enormous economies, and such a clear atmosphere in our country that, amongst other things, economy in artificial lighting would be the indirect result.

Dr. J. F. CROWLEY thought the suggestion that the matter should be considered by the Joint Committee a very sound one, because upon that Committee would be representatives who would be able to see to the interests of illuminating engineering, and would have in mind the struggle the Society had had since its formation to secure due attention to the principles on which sound lighting should be based.

Apparently the point the Government had in mind in suggesting economies in lighting was the saving in coal that it was anticipated would result. In this connection, he might mention that the output of coal per mine-worker per annum had been steadily falling in this country for the past fifty years, until it stood to-day lower than the output per mine-worker per annum of any country of comparable size in the world. Whatever the cause, and he was not going to enter into that, this meant that the conservation of coal would become an increasingly acute problem. Since the quantity of coal used for power purposes in this country was so very much greater than the quantity of coal used for lighting, it might be well to note that in all efforts that were being made to promote economy in the use of the coal used for power purposes there was no proposal to reduce the amount of power used in industry. On the contrary, the view was held that if we were to be successful in industry in thef uture, we must use power to a greater extent than hitherto. The conservation of our coal supplies, therefore, in so far as it applied to the coal used for power purposes could only be made effective by economy in the methods adopted for producing and applying power. In regard to lighting he felt also that our natural tendency ought to be to increase the quantity of light at present in use in industry rather than to restrict it, while securing the necessary economy in the fuel used for lighting purposes by the adoption of more efficient methods of illumination. He was assuming, of course, that the proposed economy in illumination was not a temporary war measure, which would necessarily have to be dealt with as such, but that it was being considered as part of the whole problem of the conservation of coal after the war now under review, and his suggestion was that every endeavour should be made to secure the most efficient methods of illumination in accordance with the principles the Illuminating Engineering Society had been inculcating for so many years, with restrictions only on luxury in lighting, display advertisements, &c.

As Mr. Faraday Proctor pointed out, the saving in the coal used for lighting purposes would in any case be a small matter, and our real saving would result from greater efficiency in the methods of producing and distributing power, to which he had already referred.

Mr. J. S. Dow said that although it was generally agreed that the saving possible in the amount of coal used for lighting purposes was a small fraction of the whole, yet it must be remembered that the margin available for lighting in normal times was also small. The reduction of output since 1913 was greater than the amount normally allotted to lighting. Therefore in this field even a small saving might be important. In some districts at the present time supply companies found a difficulty in coping with the industrial demand, especially during the peak hours. If purely luxury and spectacular lighting could be diminished in these hours it might be of material help, and it was surely better to make sacrifices in this direction than to run the risk of insufficient industrial supply.

Moreover, the elimination of waste of light formed part of the Society's permanent programme and it was natural and legitimate to extend their educational work in this direction at the present time when waste was specially undesirable.

Mr. Gaster had referred to the display of bright lamps outside places of entertainment; if persisted in during the winter days this was a not inconsiderable item, and in the present darkened condition of the streets glaring methods were particularly objectionable. The matter was also of importance for the future because, when the lighting restrictions were removed there would be a danger of a reaction towards the indiscriminate display of bright lights—especially in view of the ease with which the half-watt lamps could be installed. It would be much better if more artistic and economical methods, such as the flood-lighting now becoming usual in the United States, could be brought to the notice of such consumers.

In regard to shop lighting, again education in the proper use of light was badly needed. Many crude and wasteful methods such as the use of naked lamps or lamps screened with coloured paper still survived. The Society had for years advocated the screening of sources so as to throw the light on the goods, the lights themselves being invisible from outside the window.

These would be matters for the consideration of the Committee Mr. Gaster had suggested, and it might be a good plan for the members to prepare readable pamphlets, addressed to various sections of the community, pointing out the essential principles of good lighting and the inconvenience of wasteful display.

The CHAIRMAN (Mr. A. P. Trotter) said he had given some attention to the matter but had found the problem somewhat complicated. A distinction should be drawn between general economy and war economy. Circulars had already been issued asking the public to economise in lighting for the sake of the ensuing saving of coal. But when we came to consider the economy of a spontaneous nature which most people were now practising in their domestic arrangements it would be found that the coal saved was small in comparison with the saving in lighting bills—certainly not more than 10 per cent., or one penny in the shilling, in the personal saving to the pocket of the consumer.

At the same time he thought there were directions where economy might fitly be exercised. They all remembered what a dismal place London had become before last Christmas. The modification in the general lighting had been welcome, but there was a great deal of unnecessary lighting outside theatres and restaurants. As Mr. Gaster said, people knew where to go for entertainment without it being necessary to attract them by a blaze of light. The lighting outside some tobacconists' shops in the Strand was absolutely painful and dazzling. Such conditions were always undesirable and particularly so at present; yet, while economies in this direction might be expected now, he was not sure that it would not be considered undue interference with the liberty of the subject to say that this must not be done after the war.

There was one considerable waste going on in many parts of London, namely the lighting by arc lamps in opal globes, the surfaces of which were painted black, or nearly so. This was absurdly extravagant. Such lamps originally took 9 amperes and even now were taking 7 amperes, and the current could not be further diminished without interfering with the regulation of the lamp. These lamps could be replaced by small incandescent lamps giving more light but taking

far less current. With a 60-volt lamp no alteration in the wiring would be required and why such an obvious economy was not more widely practised he could not imagine.

Mr. L. GASTER, replying to various points in the discussion, said that the question of economy in the use of coal for power production, referred to by Mr. Faraday Proctor and Dr. Crowley, was a most important matter. The various speakers agreed with him that the saving in coal through lighting diminution was necessarily a small item. Nevertheless, the consideration of lighting had a moral justification because this form of waste came so prominently before the public eye. The general public, who probably did not understand that illumination was responsible for but a small fraction of the total coal consumption, were apt to assume, when they saw evidence of the lavish display in lighting, that the need for economy was not so great as had been represented.

In addition, as Mr. Dow had remarked, our present action must take account of the future. If people could be induced to adopt proper methods of lighting now they would be less likely to return to wasteful ways when the present restrictions were removed.

In view of the fact that the authorities were already considering this matter, he thought that the formation of a small Joint Committee by the Society would be helpful. It would be able to assist them by pointing out directions in which lighting economies could be exercised without undue hardship and in preventing hastily contrived regulations which tended to undermine authority and create dissatisfaction.

It was naturally impossible for Government Departments, in these times of pressure, to survey the entire field and take account of circumstances which were only familiar to technical men. As a matter of principle Government Departments should welcome the assistance of scientific and technical societies in surveying the ground and providing statistical data before regulations were made.

A cordial vote of thanks to Mr. Gaster terminated the discussion, the Chairman remarking that the formation of the suggested committee might be safely left in his hands.

It was announced that the opening meeting of the next session would take place in November.

SIGHT AND SIGNALLING IN THE NAVY.

A contribution by A. Duane in the Proceedings of the American Philosophical Society (No. 5, Vol. LV., 1916) describes in detail the various types of signals—semaphore, flashing lights, fixed and moving colours, special forms, etc.—that a skilled signalman in the Navy must interpret. Expertness in this branch makes a severe call on the efficiency of the eye. It is recommended that "the standards of vision and colour vision now required in the Navy should by no means be diminished but rigorously maintained." Tests should relate not only to vision (perception of form and colour) but also to the reaction time required to receive and record impressions.

Obituary.

We learn with regret of the death in action of Corporal L. S. Anderson, Manchester Regiment, who was reported missing in July last, and now officially presumed to have been killed on that date.

Corporal Anderson was a member of the Illuminating Engineering Society, and, previous to joining the Forces, was associated with the Lancashire Electric Power Company.

AN INVESTIGATION ON RADIUM LUMINOUS COMPOUND.

By CLIFFORD C. PATERSON, J. W. T. WALSH and W. F. HIGGINS.

(Abstract of a Paper read before the Physical Society on May 25th, 1917.)

IN this Paper is given an account of work carried out at the National Physical Laboratory on Radium Luminous Compounds. The investigations originated in a request by the Admiralty for information and assistance in connection with the use of this material for the dials of large numbers of instruments used by the Navy.

The standard of luminosity for the paint (generally known as the N.P.L. Standard) was fixed in absolute measure in December, 1915, and that for the dials themselves shortly afterwards, and many thousands of luminous instrument dials have since been passed through and measured for conformity with the standards laid down.

The subject is a comparatively new one, for the value of radium luminous compound has only been recently recognised in connection with commercial apparatus. Photometric measurements of the brilliancy of zinc sulphide under the action of the radiations from radium products were made by Marsden in 1910,* who directed the radiation from a tube of emanation on to a zinc sulphide screen and measured the luminosity produced. The luminosity was found always to decay at a more rapid rate than the emanation.

In a Paper in 1915,† Mr. H. Hughes, describing the Creagh-Osborne compass, dealt with the use and appplication of radium compound to prismatic compasses, and in a further Paper to the Optical Society in June, 1916, F. Harrison Glew‡ dealt with the general question of luminescence, and considered the practical uses to which radium luminous compound may be put, as well as the method of application of the compound to a surface in order to produce the maximum luminosity. Mr. Glew gave a further lecture on this subject to the Illuminating Engineering Society,* followed by notes on the behaviour and testing of luminous paint by Mr. J. S. Dow and Mr. A. Blok.

Measurement of Luminosity.—The measurement of the luminosity of radium paint is rendered difficult by two considerations—(i.) the green hue of the light emitted, (ii.) the very low brightness to be measured. It is desirable at the outset to make determinations of luminosity in absolute rather than relative measure, and comparisons have therefore to be made with the ordinary photometric standards.

(i.) The very green hue of the light given by radium compound necessitates the use of a green filter when photometering it. A good match is obtained by the use of a sample of glass made by Messrs. Chance Bros., known as "B.O.T. Light Green," and corresponding with the lightest shade of green glass permitted for ships' starboard navigation lights. The expression of the luminosity on absolute measure entails the determination of the transmission coefficient of the filter.

(ii.) The degree of brightness required to be measured is of the order of 10 microcandles per square centimetre, or 0·03 equivalent foot-candle.†

* Roy. Soc. *Proc.*, lxxxiii., pp. 548-561, 1910 *Sci. Abst.*, lxxvi. A., 1911.

† *Improvements in Prismatic Compasses*, H. A. Hughes, *Trans.*, Opt. Soc., Lond., Vol. xvi., p. 17.

‡ *Radium and Other Luminous Compounds*, F. Harrison Glew, *Trans.*, Opt. Soc. Lond., Vol. xvi., p. 276.

* *Illum. Engineer*, March, 1917.

† This is a convenient unit of brightness, and represents a brightness equal to that of a perfectly diffusing surface with a coefficient of reflection of 100 per cent., when illuminated to an intensity of 1 ft.-candle (*i.e.*, by a source of 1 candle placed 1 ft. away from the surface in the direction of its normal).

This degree of illumination is one at which the Purkinje effect is operative, so that the transmission coefficient of the green filter must be determined at an illumination corresponding with the brightness of the paint with which it is to be used, and it must be ensured that the surfaces to be compared are really in juxtaposition without any intervening space to separate their images on the retina.

The apparatus is shown diagrammatically in Fig. 1.*

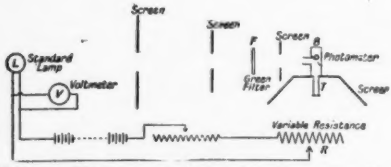

FIG. 1.—Diagram of Apparatus for measuring the Brightness of Radium Luminous Compound.

L is a tungsten filament lamp mounted on the carriage of a 30 ft. long photometer bench. It is fed from a storage battery, the pressure at the lamp terminals being controlled by a resistance, R, which is to the hand of the observer. The value of the pressure applied to the lamp terminals is indicated by a voltmeter, V. F is the special green filter. It reduces the hue of the light given by L to that of the radium compound. B is a small brass box, 120 mm. long by 37 mm. square, and shown in more detailed plan in Fig. 2.

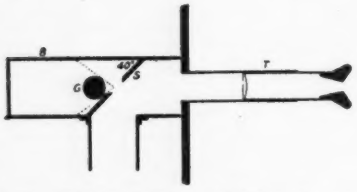

FIG. 2.—Detail of Box containing the comparison surface and tube of compound.

It contains S, a sheet of matt white celluloid set at an angle of 50 deg. to the axis, in the centre of which is cut an oblong aperture, 4·5 mm. high by 7mm. broad. The relative dimensions are such that when the screen is looked at through the telescope the aperture has the appearance of a small square with 4·5 mm. sides. This aperture is cut with a sharp bevel, so as to reduce to the smallest possible dimension the black edge between the illuminated screen and the surface of the radium compound.

The radium compound is contained in a glass tube, G, and wedge-shaped guides are arranged inside the box to assist in placing it centrally behind the aperture in S, no matter what may be the diameter of the tube.

The transmission coefficient of the filter F was determined from the mean results of five experienced photometric observers, each of whom matched the brightness of three separate samples of radium paint against the brightness of the screen S. The illumination of S was varied by moving the lamp L along the line LF until a match of intensity was obtained. This was done (i.) with the filter F removed and, (ii.) with the filter in place. The mean ratio of the illuminations was taken to represent, for the conditions under which the apparatus is used, the transmission coefficient of the filter for an "average" eye.

Absorption of Glass Tubes.—The radium paint being in powder form, it is necessary to measure its brightness when enclosed in a glass tube.

Variations in the thicknesses of the glass containing tubes, up to at least 1·3 mm. makes no difference to the brightness of the paint viewed through them.

The coloration of the glass by the action of the radium, on the other hand, produces a progressively increasing absorption for which allowance has to be made in considering the decay of luminosity of the compound. Lead glass gives a brown coloration and soda glass a purple one.

Measurements have been made of the amount of this effect in the case of six of the samples of compound studied, all of which were contained in soda glass tubes. The results are given in Table I.

* A very similar apparatus is described by Mr. Blok to the Illuminating Engineering Society, March, 1917.

TABLE I.

Sample.	Age of compound.	Total absorption due to coloration.
	Months.	Per cent.
3	14½	13
6	17	8
7	17	9
8	11½	10
9	13	10
10	13	16

Testing of Dials.—The only satisfactory way of testing the actual brightness of the luminous markings, is to compare the dial under test with another dial the markings of which are of the same pattern and dimensions, and of known brightness.

This was done with the apparatus shown in Fig. 3 which consists of a box which

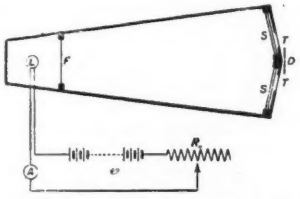

FIG. 3.—Diagram of Apparatus for Measuring the Brightness of the Markings of Luminous Dials.

encloses at one end an electric lamp, L, in circuit with a resistance, R, and precision ammeter A. R is to the hand of the observer. L is actually a 105-volt 60-watt metallic filament lamp operated when giving standard brilliancy at about 5 watts per candle. In front of L is a sheet of Wratten "Minus Red" filter F, in order that the hue of the light may match that of the radium compound. The green light then falls on two screens SS, each consisting of two thicknesses of thin white paper with a space of 10 mm. between them. In front of the screens are placed two stencils TT, each consisting of a sheet of thin brass or copper 0·3 mm. thick, framed in wood to fit the dimensions of the screens (255×275 mm.). The figures and graduations are cut in brass on an engraving machine, so as to be identical with the luminous markings of the dials under examination. Between the stencils is fixed the dial under test D.*

The test is made by adjusting the current furnished to the comparison dials until the three dials are of equal luminosity the current then furnishing an indication of the absolute brightness. The luminosity on standard dials is 0·0075 equivalent foot-candle.

As a result of investigation it has been found the proportion of width of line to height of letter for maximum legibility should be about 1 to 8, and should not much exceed 1 to 7, at any rate for letters and figures in which the height exceeds about 5 mm. Below this limit experience suggests that the breadth of line may be usefully increased to one-sixth of the height of the figure.

Decay of Luminosity.—It is known that the luminosity of radium paints, both in the form of powder and varnish, first rises to a maximum after mixing, and then commences to fall, at first gradually, then more rapidly, until after six or seven weeks from the date of mixing the rate of decay settles down into a logarithmic law ($B/B_0=e^{-k}$). This law applies for a period of 150—200 days, but after that period the luminosity diminishes less rapidly than the law would suggest.

Some typical results are shown in Fig. 4.

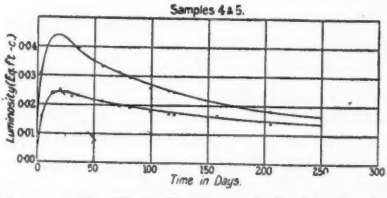

FIG. 4.—The Early Portions of the Luminosity Curves for Samples of Compound containing Radium in the proportion of 2 : 1.

Fig. 5 shows a family of luminosity curves based on the average data at present obtained for compounds made up with different proportions of radium

* The advantages of this position of the dials were discussed at the meeting of the Illuminating Engineering Society on March 22nd. See *Illum. Eng.*, March, 1917, p. 87.

salt in the same quality of zinc sulphide, this sulphide being assumed to have characteristic constants of a fair average value.

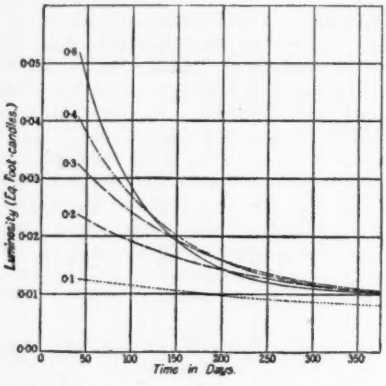

FIG. 5.—Theoretical Luminosity Curves for Samples of Radium Content (mg./gm.) shown against each Curve. (Constants of Decay assumed of Fair Average Values.)

It is interesting to note that the luminosity standards for the dry compound and for the painted dials are 0·03 and 0·0075 ft.-candles respectively, *i.e.*, in the ratio of 4 : 1. If we assume curve 0·4 of Fig. 5 to represent the behaviour of the compound before application to dials the 0·1 curve may be taken to represent, both as regards initial brightness and decay, the behaviour of the material after painting.

For the compound alone (as distinct from painted dials) after the first six months, the luminosities of compounds of all contents between 0·2 mg. per gramme and 0·8 mg. per gramme are the same to within 20 per cent.

In the case of instruments of which the life under normal working conditions is appreciably less than six months the use of a compound containing, say, 0·6 mg. per gramme or over might be of advantage provided it could be ensured (*a*) that the dials were painted within three weeks of the preparation of the compound, and (*b*) that the instruments were not kept in store for more than a month after painting. Probably, in ordinary circumstances, these conditions would not be easy of realisation, and the use, therefore, of a compound of greater radium content than about 0·4 mg. per gramme may be ruled out.

In cases in which the compound is employed in powder form, the minimum useful radium content is only a little below 0·2 mg. per gramme, and except on the score of expense alone it is not desirable to employ a compound of less radium content than this, because the luminosity of the 0·1 mg. compound after an indefinitely long period is still nearly 20 per cent. below that of the 0·2 compound.

Similarly for compound used in painting dials, 0·4 mg. per gramme is the best content to use if final luminosity is not to be sacrificed. Some 50 per cent. saving of cost should result from the use of compound for painting dials containing 0·2 mg. per gramme, but the final luminosity would be somewhat less. It should be remembered that there is nothing appreciable to be gained by the use of compounds for dials *below* this last-named limit because it will be nearly as economical, and a better result will be achieved by employing a smaller quantity of the better grades of compound instead of the large quantity of a compound of lower radium content.

DISCUSSION.

Mr. F. H. GLEW pointed out the difference in brightness occurring if tubes are painted on the inside and the radioactive effect had to pass through the material in order to produce luminosity. He also suggested that it might be preferable to place the colour-filter in the eye-piece of the photometer instead of between the lamp and the screen.

Dr. H. S. ALLEN said that an investigation of the physical condition of the zinc sulphide used would be useful.

Mr. J. S. DOW referred to the difficulty of specifying a standard of absolute brightness, and the change in the colour of the light, which apparently became greener as the decay progressed. He had carried out a test on a tube painted inside with zinc sulphide and containing radium emanation. The original brightness of this was as much as 1/5th of a foot-candle, but in three weeks it fell to 1/60th of this value. A marked effect in this tube was the formation of

local bright spots, to which Mr. Glew had drawn attention.

Dr. LEVY said that different samples of zinc sulphide yielded light of distinctly different hues when stimulated by daylight, but he had not noticed any difference when they were stimulated by radium. A specimen might be poor with daylight but good with radium excitation, but the converse did not hold good.

Mr. T. SMITH advocated placing the coloured screen as near the lamp as possible, as this itself might appreciably act as a source of light. It would be better to enclose the material in a tube with flat sides rather than a round tube.

Dr. S. RUSS asked if tests of the decay of fluorescent screens for use with X-rays had been made.

Mr. WALSH, in reply, pointed out that the use of a colour-filter in the manner suggested by Mr. Glew would involve a double correction. Changes in colour with age and in different samples submitted had been observed, but were not easy to measure quantitatively. They had no data on the relation between daylight and radium excitation. The order of accuracy was not appreciably affected by the position of the coloured screen. As regards the enclosing tubes, they had to employ those in which the material was sent.

ARC LIGHT UNDER PRESSURE.

Some experiments on the operation of electric arcs under pressure are described by Dr. W. Mathiesen in the *Electrotechnische A. Zeitschrift.** An increase in efficiency might be obtained in this way, but there appear to be difficulties in the employment of such pressures at present. Pressures from 3·4 atmospheres vacuum up to 5 atmospheres compression were studied. With an inclined negative carbon an increase in pressure from 0 to 5 atmospheres raised the efficiency from 0·26 to 0·13 watt per candle, but in general at the higher pressures the arc becomes very unstable. While it is possible to work up to 5 atmospheres with vertical carbons, in the case of inclined carbons the arc becomes too erratic if 1 atmosphere is exceeded. A test reported for vertical carbons suggests that the gain in efficiency with vertical carbons is not great, the specific consumption with a rise in pressure from 0 to 3 atmospheres falling from 0·725 to 0·68 watts per candle, and then subsequently increasing at 5 atmospheres to 0·945 watts per candle.

* Oct. 12th and 19th, 1916.

THE NERNST VAPOUR LAMP.

Some recent patents of Dr. Nernst* relate to arcs struck between carbon electrodes in atmospheres of zinc, aluminium and titanium chloride. The latter appears to be specially suitable for the object in view. The efficiency obtained in such lamps is said to be similar to that obtained with mercury vapour lamps. A resistance in series with the arc is utilised to volatilise the salt used.

In a second patent suitable salts are added to mercury vapour to produce a white light. Special arrangements have to be made to prevent the foreign ingredient being gradually removed by the mercury. A suitable mixture proposed is 70 per cent. zinc chloride, 15 per cent. calcium chloride, 5 per cent. thallium chloride and 5 per cent. cæsium chloride. Such a lamp, taking 4 ampéres at 120 volts, is stated to give 3,000 Hefners and operate at 0·16 watt per Hefner.

* *Elektrotechnische Zeitschrift*, Vol. 40, 1916; abstr. *Electrician*, June 8th, 1917; German patents 288,228 and 288,229.

FLOOD-LIGHTING OF THE CAPITOL, WASHINGTON.

REFERENCE has been made in the *Illuminating Engineer* to the interesting precedent established by the use of flood-lighting to illuminate the Capitol in Washington, U.S.A. This is a building of architectural distinction as well as national interest, and possesses an imposing dome which has been likened to that of St. Peter's in Rome.

The Capitol stands on a hill overlooking the Potomac river and can be seen for many miles around. It is even more striking when illuminated by night. The dome is 135 feet in diameter at the base and 218 ft. high above the roof. Around the base are fluted columns.

The lighting installations consisted of 84 flood-lighting projectors each equipped

FIG. 1.—General View of the National Capitol (Washington) under Flood-Lighting.

The external lighting of this building was specially designed to show up its proportions and characteristic architectural features. An interesting account of the arrangement was contributed by Mr. J. A. Summers to the *General Electric Review* (U.S.A.) for May, from which these particulars and the accompanying illustrations are reproduced.

with a 400-watt incandescent lamp. The projectors were placed in four banks, 21 in each bank, about 200 feet from the base of the dome on the corners of the House and Senate wings of the building. The positions of the units were carefully selected with a view to cutting out unduly sharp shadows, the columns being illuminated from different directions so as to avoid any harsh effect

and yet prevent an impression of "flatness."

The building itself was illuminated to a lower intensity, so as to form a setting for the dome. In ordinary circumstances the building receives a certain amount of illumination from a few ornamental posts with lamps in white opal globes, placed at regular intervals on the parapet. To provide additional

FIG. 2.—Dome of Capitol (Washington), illuminated by Flood-Lighting Projectors.

illumination thirty-four supplementary posts in the same style were added, but each carried a 400-watt floodlighting projector instead of the customary opal globe. It is stated that the units were not at all conspicuous.

The effect of the lighting may be judged from the accompanying illustrations. The illumination was first used on the occasion of the inauguration of the building by President Wilson.

FLOOD-LIGHTING STAINED-GLASS WINDOW.

An interesting application of flood-lighting is reported from the United States in a museum devoted to art work of various kinds. There was on exhibition a very fine stained-glass window, which on bright days could be readily shown, but on dull days could not be exhibited satisfactorily, as the colours were not well brought out by the relatively weak light.

This difficulty has been overcome by fixing, some distance outside the window, a gas-filled lamp in a concentrating reflector so as to illuminate the window by artificial light. The effect is said to be quite good, and the window can now be exhibited independent of the climatic conditions. The relatively white light given by the gas-filled lamp is also considered to be an advantage.

A NEW STYLE OF STREET LIGHTING.

We notice that in Brownwood, Texas, a town of about 12,000 inhabitants, a somewhat novel system of electric lighting is being installed. The method consists in placing a 100-watt lamp in opal globe under the awning of each shop entrance. It was agreed that the system would not be applied to any block unless the entire block was uniformly lighted. About 400 lamps have already been installed, and it is stated that a good effect on the window lighting has also been produced, quite a number of prominent stores taking the opportunity to bring their illumination up to date.

REVIEWS OF BOOKS.

Hawkins' Electrical Guides. (*Messrs. Edwin A. Mansfield and Co., Electrical Engineers, 12, Beckenham Road, New Brighton. 5s. per vol.; £2 10s. the complete series of 10 volumes.*)

WE have had an opportunity of inspecting the *Hawkins' Electrical Guides*, a series of volumes emanating from the United States.

The subject-matter covered by the series is as follows :—

No. 1. Elementary Electricity, Magnetism, Induction, Dynamos, Electric Machinery.

No. 2. Construction of Dynamoes, Motors, Armatures and Armature Windings, Installation of Dynamos.

No. 3. Electrical Instruments, Testing, Practical Management of Dynamos and Motors.

No. 4. Distribution Systems, Wiring, Wiring Diagrams, Sign Flashers, Storage Batteries.

No. 5. Alternating Current and Alternators.

No. 6. Alternating Current Motors, Transformers, Converters, Rectifiers.

No. 7. Alternating Current Systems, Current Breakers, Measuring Instruments.

No. 8. Alternating Current Switchboards, Wiring, Power Stations, Installations and Operation.

No. 9. Telephones, Telegraph, Wireless, Bells, Lighting, Railways.

No. 10. Modern Practical Applications of Electricit,y and Index.

To cover such a variety of ground is certainly a *tour de force*. The language is concise and simple, and the guides are stated to "give a complete course in electrical engineering without correspondence." Those who, as instructors in technical colleges, have grappled with the task of explaining the fundamental principles of alternating currents and dynamo-electric machinery, will appreciate the difficulty of grasping such conceptions through the printed page. In this case the difficulty is partly met by a lavish use of illustrations and the insertion of queries and answers on the subject-matter.

While in our opinion nothing can adequately replace personal contact between professor and student, and the handling of concrete things in the workshop and laboratory, the possessor of these guides has a series of reference books containing a considerable amount of information. They would form a useful supplement to courses of instruction or workshop experience.

Electrical Engineering Practice, by J. W. Meares and R. E. Neale. (*E. and F. N. Spon and Co., Ltd., 57, Haymarket, London. 521 pp., 86 illustrations. 3rd Edition. 25s. net.*)

THIS work, in its present extended form, makes an attempt to fill the gap between pocket-books of bare data and highly technical treatises. The language is concise, and the authors have illustrated each point by many practical illustrations and useful data.

The early chapters are elementary, but the reader is soon led on to practical information of wiring, lamps, motors, and installation work generally. Power transmission, traction, hydro-electric plant, and electric driving receive special attention, and there are two final chapters on specifications and testing. We notice that illumination is dealt with, necessarily briefly, but in an up-to-date manner.

The authors appear to have been careful in their choice of symbols, and the list of books for reference at the beginning of the book is a useful feature. Possibly, in view of the wide ground covered, it might be useful in a future edition to add to certain chapters a list of some of the chief contributions to proceedings of technical societies or technical journals indicating where more detailed information may be found.

SHORT NOTES ON ILLUMINATING ENGINEERING.

INVESTIGATIONS ON INCANDESCENT MANTLES.

We understand that the Bureau of Standards (Washington, U.S.A.) has been conducting an exhaustive investigation on the efficiency of incandescent gas mantles, with special reference to the influence of varying quality of gas.

Inspections of more than 6,000 installations in ten different cities have been made, and it is believed that the results will strongly illustrate the benefits of regular attention in the maintenance of lamps and fittings.

It is stated that a report on the whole subject is in course of preparation.

THE OPTICAL SOCIETY OF AMERICA.

In the Transactions of the Illuminating Engineering Society, U.S.A., it is mentioned that an Optical Society has recently been formed in America for the study of optics and optical instruments and apparatus.

The officers of this new Society include a number of active members of the Illuminating Engineering Society, the President for the current year being Mr. P. G. Nutting.

SPECIAL LIGHTING FITTINGS.

At a meeting of the South-Western Electrical and Gas Association, held in Dallas, Texas, U.S.A., on April 26th, Mr. J. G. Barret read a paper on "Illumination *versus* Raw Light." The author pointed out the value to supply companies of encouraging the design and use of special lighting fittings for specific purposes, which would often result in new lighting business being opened up. Among the units of this kind he mentioned porch lights, lights for school buildings, "daylight" illumination for shops, ribbon counters, &c.

The object of the company should be to demonstrate the convenience and ease of application of electric light for all purposes, and therefore the use of special appliances for specific purposes should be generally encouraged.

STREET LIGHTING WITH OIL LAMPS IN PARIS.

Centuries ago Paris was the foremost city in Europe in the provision of oil lanterns in its streets. In a contribution to the *American Gas Engineering Journal* Mr. F. Miltoun states that hundreds of these old lanterns still exist, and some of them are now to be seen burning feebly at the street corners. It is proposed that the famous Esplanade des Invalides will be so lighted.

This step appears to be a precaution in view of possible shortage of gas. Since the outbreak of war the situation in this respect has become more acute, and though gas is still sold at 20 centimes, it is said to cost 28 centimes to produce. According to Mr. Miltoun, no new installations are being made at the present time.

ECONOMIES IN PUBLIC LIGHTING.

In the House of Commons Mr. Lough recently asked the Home Secretary whether any Borough Councils had intimated their desire to economise coal and other supplies by reducing public lighting during the summer; whether certain gas companies had stated that they were unable to carry out the reduction because of the Lighting Regulations under the Defence of the Realm Act; if so whether the Government still regarded economy in coal consumption as desirable? Further, would he take steps to make it clear that local authorities should be enabled and encouraged to bring about economies by reducing waste of gas and electricity in the same way as had been accomplished by the regulation prescribing the early closing of shops?

Mr. Brace replied that representations on the subject had been received from several Borough Councils. It was most desirable to secure economy in consumption of coal in every possible way, but important for military reasons that any reduction in lighting should be carried out uniformly throughout the Metropolitan area. He had been in communication with the military authorities on the matter, and hoped in a few days to communicate with the Borough Councils with a view to securing such saving as might be possible during the summer months.

SUMMER TIME IN GERMANY.

According to the *Gas World*, the German Gas Association some time ago circulated its members with a view to eliciting opinions regarding the effect of the "summer time" also being adopted in that country.

The general impression appears to be that the saving brought about has been small. Gas companies have not been very favourably affected, as although it has presumably led to a small coal saving. the fixed charges remain.

It is interesting to observe that according to the statistics obtained by the Gas Promotion Centre the effect of summer time was to cause a drop of about 5 per cent. during the summer months, which is approximately 1·7 per cent. of the annual consumption.

This is curiously close to the estimate made by Mr. Faraday Proctor, in his evidence before the Committee on the Summer Time Act, of the saving in electricity brought about in this country.

OPTICAL TECHNOLOGY IN FRANCE.

It is interesting to observe that, according to *La Nature*, proposals are now being made in France to secure greater facilities for training in optical technology. The proposals include a College of Optics, a Central Laboratory for Optical Testing and Experiments and a special Optical Trade School. It is also suggested that a suitable journal, devoted exclusively to optics and optical instruments, should be published.

It is pointed out that this subject is of interest to a wide circle of the public, including officers in the Army and Navy, illuminating engineers, manufacturers of optical instruments and appliances and many others.

THE SOCIETY OF GLASS TECHNOLOGY.

A meeting of this newly-formed Society was held at the Institute of Chemistry, by invitation, during May, Mr. A. S. Esslemont presiding. Professor Herbert

Jackson, who received the congratulations of the meeting on his F.R.S., gave an address summarising the recent researches carried out by the Institute in regard to such varieties of glass as (1) resistant and chemical glassware; (2) soft glass for lamp work, (3) combustion tubing; (4) glass for X-Ray work; (5) optical glass; (6) opal glass of different kinds; (7) thermometer glass.

About 50 different formulæ had been prepared by the Institute, and were available for manufacturers to experiment with.

Professor Jackson referred to the formation of the Society as an important step to co-ordinate the labours of the manufacturer and the scientist, another important matter being the formation of the department of Glass Technology at Sheffield University.

Previous to the meeting the members paid a visit to the works of Messrs. Powell and Sons, Whitefriars.

A POLARISATION FLICKER PHOTOMETER.

A contribution in the *Philosophical Magazine* for April, by H. E. Ives, describes an interesting form of flicker photometer, in which the alternate exhibition of the two photometric fields is brought about by means of a cop rotated Nicol prism. The light from the two surfaces is first polarised in two planes at right angle to each other. When the Nicol is rotated the two images wax and wane in quadrature, each becoming bright as the other fades away.

As a result the stimulus follows the cosine law closely. This enables the author to investigate the theory of the instrument, and to deduce quantitative relations justifying the accepted views of the function of photometers of this class.

INSTITUTION OF GAS ENGINEERS.

Annual Report of the Council.

The Annual Report of the Council of the Institution of Gas Engineers contained a series of references to various important researches carried out during the past year, notably through the Committees on the Life of Gas Meters, Refractory Materials and Gas Lighting, Heating and Ventilation. The Institution is also represented on the Board of Scientific Societies, the British Association Fuel Economy Committee, the National Gas Council, and other important bodies.

The Report also contains *in extenso* the Draft Standard Specification on Streetlighting prepared by the Joint Committee composed of representatives of the Institutions of Gas and Electrical Engineers, the Institute of Municipal and County Engineers, and the Illuminating Engineering Society, which it is hoped will be found useful when methods of streetlighting are reviewed after the war. In this connection a statement of the minority of the Committee is presented, expressing the view of the Council of the Institution of Gas Engineers that contracts for streetlighting should be based on the average candle-power of light sources ascertained at two or three different angles.

This Report was presented at the Annual Meeting of the Institution this month, when the President, Mr. A. E. Broadberry, gave the customary address. Reference was made to the important step taken in the formation of the National Gas Council, whose work, in many directions, will supplement that undertaken by the Institution.

EFFECTIVE SHOP-WINDOW LIGHTING.

An article by H. W. Mather in the *Electrical Review and Western Electrician* discusses some of the fundamental points in shop-window lighting. It seems to be now agreed that as a rule the best place for the main lighting is the top edge of the window. Proper reflectors, selected according to the depth of the window, are very important, and the background should also be chosen with care. It is better to avoid shiny and polished surfaces, but if these are used they should preferably not be carried right up to the ceiling; in this way one can avoid irritating direct reflections of lamp filaments, likely to be visible to persons outside the window.

Another point on which there is agreement is that shadowless illumination is not desirable. On the contrary, provisions should be made for fairly sharp contrasts. The use of lamps approaching "artificial daylight," or at least fairly white in colour, is desirable when blue-coloured goods are to be shown and there is an almost unexplored field for ingenuity in the production of pleasing colour-harmonies.

The intensity of illumination in a well-lighted window may be of the order of 10—50 ft.-candles (this, of course, applies to normal lighting conditions; considerations of economy and lighting restrictions affect the problem in this country). The specification of the consumption of energy for windows of specified dimensions is a rather awkward problem. Much depends on the type of lamp and reflector employed and the relation between depth and height of window. In the United States formulæ have been derived for windows of different size and shape, assuming the use of prescribed lamps and reflectors; in this country the problem does not seem to have yet been standardised in detail.

RESTRICTION OF SHOP AND SIGN LIGHTING.

The following Order has been issued under the Defence of the Realm Regulations, dated May 22, 1917, prohibiting the use of lights of certain descriptions for purposes of advertisements of display:—

(1) All lights of the following classes and descriptions shall be extinguished and such lights shall not be lighted at any hour except as provided in paragraph (2) hereof—

(*a*) Sky signs, illuminated facias, illuminated advertisements and other lights used outside or at the entrance to any shop or place of amusement or any other premises for the purpose of advertisement or display;

(*b*) Lights used inside any shop for the purpose of advertisement or display when the shop is closed for serving customers.

(2) This Order shall not apply to any public street light or any other light approved by the Chief Officer of Police as necessary in the public interest.

(3) The expression "shop" in this Order has the same meaning as in the Shops Act, 1912.

This Order shall apply to the whole of England and Wales and shall take effect on and after the 29th May, 1917.

This Order may be cited as the Advertisement Lights Order of the 22nd May, 1917.

IMPERIAL MINERAL RESOURCES BUREAU.

A Bureau with the above title is to be formed in London to survey the mineral resources of the Empire and their development. We understand that a scheme for the establishment of the Bureau is being prepared by a Committee appointed by Dr. Addison, Minister of Munitions.

TOPICAL AND INDUSTRIAL SECTION.

[At the request of many of our readers we have extended the space devoted to this Section, and are open to receive for publication particulars of interesting installations, new developments in lamps, fixtures, and all kinds of apparatus connected with illumination.

The contents of these pages, in which is included information supplied by the makers, will, it is hoped, serve as a guide to recent commercial developments, and we welcome the receipt of all *bona-fide* information relating thereto.]

INDUSTRIAL FITTINGS FOR HALF-WATT LAMPS.

In an illustrated article in the *Beama* journal Mr. H. C. Wheat recently described a number of standard modern fittings for use with half-watt lamps, especially in regard to industrial lighting. Reference is made to the important factors of strength and rigidity, adjustment, ventilation, supports and cleaning.

The following points deserve special attention :—

Reflectors should be of the correct form for the particular service required. The shape varies not only with the different types of distribution but also with the particular form of reflecting surface required.

Centring of light source. Where variations in the position of the light source appreciably affect the result (as is generally the case) provision must be made to permit of its being centred ; also some form of indicator should be embodied in the design so as to enable ordinary persons to effect the required adjustment correctly.

Size of Reflectors and Globes should be sufficient to present an adequate surface for the reflection of the light, to ensure satisfactory diffusion, and reduce intrinsic brilliancy to a reasonable figure. Quality of glass must be such as to secure greatest possible diffusion with minimum loss of light.

The article also deals with illuminating engineering generally and contains a number of diagrams and photographs of modern installations.

The British Thomson-Houston Co., Mazda House, 77, Upper Thames Street, London, E.C., have issued a reprint of this article copies of which can be obtained on application to the company.

THE WEDGE OPTICAL PYROMETER.

This instrument, developed by the Optical Pyrometer Syndicate (Temple Chambers, E.C.), is intended to facilitate the measurement of temperatures from 500 degrees upwards.

The observer looks at the glowing material through an eye-piece and telescope attachment and sees a magnified image.

By inserting gradually a wedge-prism of absorbing glass the image can be dimmed until the colour just disappears.

This is taken as an indication of the temperature of the incandescent surface. The pyrometer is claimed to be specially suitable for annealing, case-hardening, and similar operations.

Catalogues, etc :—

Messrs. Turner Brothers Asbestos Co. Ltd. (Rochdale). Descriptive catalogue of insulating materials for steam power plants, hot-water installations, refrigerating plants, etc.

John Wright and Co. (Birmingham). Illustrated pamphlet descriptive of Wright's gas-heating cooking and heating apparatus for munition works.

Igranic Electric Co., Ltd. (London). Electric controlling apparatus, rheostats, switchgear, etc.

ANNUAL REPORT OF THE CHIEF INSPECTOR OF FACTORIES FOR THE YEAR 1916.

From the Annual Report of H.M. Chief Inspector of Factories for the year 1916 it is evident that inspectors have had a particularly arduous time since the outbreak of war, owing to diminished staff and the taking up of extra duties. Special reference is made to the work of Mr. Bellhouse, Dr. Collis and Miss Squire on the Health of Munition Workers Committee; of Miss Anderson, the chief Lady Inspector, in connection with the Welfare Dept. of the Ministry of Munitions, and of Mr. Sydney Smith in regard to the Reserved Occupations Committee.

Both employers and workers appear to be learning useful lessons from the present conditions. "It is fairly well recognised now that continuous and excessive overtime very soon produces lassitude and sickness among the workers and injuriously affects efficiency and both the quality and output of work." In one weaving factory special records were kept when the hours were increased from 55½ to 58 and ultimately to 65½ hours the output did not increase in proportion.

Inspectors also refer to the improvements made in factories with a view to raising the standard of health and comfort of employees. Instances are given of greater cleanliness, better heating, lighting, ventilation and sanitary accomodation, etc., and the beneficial results of these improvements.

A supplementary Report by Miss Anderson discusses the results of employment of women. By careful selection, women have been employed for very hard and heavy work. On the other hand it is stated "As regards health of substituted women it is difficult to estimate how far, if at all, heavy work causes physical injury, as there is no record of women who give up or their reasons for doing so." With a view to the future it would surely be very desirable for some such record to be kept, if the necessary machinery could be prepared.

MINISTRY OF MUNITIONS.

Official Photographs and Samples of Women's Work.

We have received from the Ministry of Munitions particulars of an Exhibition of Official Photographs and Samples of Women's Work, opened at the Royal Colonial Institute, Bristol, on May 30th, by the Lord Mayor.

The object of this exhibition is to demonstrate to engineering and other industries engaged on the manufacture of munitions the extent to which women can be employed upon responsible work of all kinds.

It will be recalled that a similar exhibition was held some time ago in London, and we do not doubt that in this case the display will be equally useful in showing the great variety of operations in which women's labour is being effectively employed.

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Claims paid over £8,500,000.

By Appointment.

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WAR ECONOMY.

In consequence of the War, the cost of building material and labour has increased nearly 50 per cent. All owners of property should therefore increase their Fire Insurances; this they can do at little or no extra cost by taking a Fire Bonus Policy with this Corporation, and thus effect a saving of 20 per cent. of each premium.

Particulars on receipt of post card at either of the above Offices.

F. NORIE-MILLER, J.P.
General Manager.

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No person can recover under more than one Coupon Ticket in respect of the same risk.

Signature .....

This Coupon must not be cut out but left intact in THE ILLUMINATING ENGINEER as that, being dated, forms the only evidence of its currency.

B.T.H. "EYE-REST" LIGHTING.

A new list issued by the British Thomson-Houston Co., Ltd., contains a very complete series of "Eye-Rest" units of various kinds (*i.e.*, units facilitating illumination with the source of light concealed from the eye).

A great variety of bowls of different design for both vacuum and gas-filled lamps are shown, and we notice that tables are provided mentioning the watt-consumption per sq. foot for different types of installations and specifying the drop from the ceiling for rooms of various dimensions. By dividing up larger rooms into squares, and using the data provided, one can get an idea of the correct spacing for large interiors. It is naturally not so easy to state the illumination to be obtained from indirect installations as it is in the case of direct lighting, owing to the influence of size of room, nature of reflecting surfaces, and other factors. It would, however, be useful if a rough indication of the anticipated results could be given, thus bringing direct and indirect data into line.

Besides the pendant units, we notice several special fittings that deserve attention, such as the floor and table standards, which combine direct and indirect illumination, and the flambeau wall brackets, likewise adapted for concealed effects.

WORKSHOP ILLUMINATION.

A leaflet under this title, issued by Messrs. Siemens Bros. Dynamo Works, Ltd., contains some remarks on methods of approaching consumers with plans for improving their lighting. In many cases the up-to-date contractor may consider it well worth while for the consumer to scrap an old installation consisting perhaps of carbon lamps and shallow enamelled iron reflectors; but he is also aware how difficult it is to induce him to consent to the necessary expenditure.

The illuminating engineering movement, which aims at the education of the public in these matters, is thus doing good work from the contractor's standpoint as well as in the true interests of the consumer himself. One of the most effective ways of impressing the consumer with the advantages of better lighting is to show him a series of photographs, taken by the actual artificial light, of good modern installations. This is the next best thing to showing him the actual installation. In all such cases the "appeal to the eye" counts for a great deal.

SOME EXPERIENCES OF RUST-PREVENTION.

A booklet issued by Messrs. Robert Bowran and Co., Ltd., described the testing and application of "Bowranite" rust-preventing paint.

A laboratory test on unprotected and protected iron is described, samples being (a) exposed to weather; (b) alternately immersed and dried; (c) hung in river at half tide; and (d) exposed to acid fumes, the test in each case lasting 46 days.

The unprotected iron was much affected, a loss of weight of 33⅓ per cent. being noted in (c), and the plate rotted through in (d). It is claimed that with the protected metal, on the other hand, no appreciable rusting or corrosion took place.